SYSTEMS, METHODS AND COMPUTER PROGRAM PRODUCTS FOR MONITORING TRANSPORT CONTAINERS

BACKGROUND OF THE INVENTION

Field of the Invention

The present invention relates to systems, processes, and computer program products for freight transportation and, in particular, for monitoring transport containers.

Description of Related Art

Security in the freight transportation industry is of great concern. Freight transportation companies and their customers are constantly concerned with products being surreptitiously removed from freight and shipping containers, railcars, trailers, or other enclosures used to store and transport products (collectively referred to herein as "transport containers"). Freight transportation companies and governmental agencies are also concerned with contraband or harmful substances or devices, such as illegal drugs, weapons of mass destruction or even illegal immigrants, being surreptitiously placed within transport containers. As a result, freight transportation companies and governmental agencies routinely use security devices, such as locks, plastic and metal loop seals and cable seals, bolt seals, security tape, security tags and memory buttons that allow tracking of transport containers, and temperature monitors, all in an effort to prevent unauthorized access to transport containers. As used herein, "access to" is intended to include physical access or entry into the interior of a transport container and/or tampering with or other manipulations of the exterior of a transport container for the purpose of gaining physical access or entry into the interior of the transport container.

However, conventional security devices are by no means fool proof. Moreover, while conventional security devices may allow a freight transportation company or governmental agency to identify unauthorized access to a transport container, such devices typically do not provide any other pertinent information, such as information relating the contents of the transport container, the individual(s) that sealed and unsealed the container for the transportation company, when and where the transport container was accessed, to what extent and for how long the perpetrator(s) obtained access to the transport container, etc. This is particularly the case when the transport container has been shipped or transported by more than one freight transportation company, to multiple destinations, and/or to multiple countries. Consequently, even when unauthorized access to a transport container can be identified, which is not always the case, it can be difficult to ascertain any other information regarding the access incident that may assist the freight transportation company and/or a governmental agency in evaluating what, if any, actions can be or need to be taken regarding the access incident, such as enforcement actions to identify the perpetrator(s), precautions for biological or hazardous material contamination or weapons of mass destruction, or remedial actions to prevent future access incidents.

Accordingly, there remains a need for improved security devices and methods for monitoring transport containers. Such devices and methods should be capable of not only detecting access to the transport container, but also when and where the access incident occurred, how long the perpetrator(s) obtained access to the transport container, as well as other pertinent information regarding the contents of the transport container and access incident. The improved security devices and methods should be capable of notifying or alerting interested parties, such as the freight transportation company and/or government agencies, when a transport container has been accessed, as well as providing pertinent information relating to the access incident to the interested parties. In addition, the improved security devices and methods also should be capable of preventing unauthorized tampering with the security device.

BRIEF DESCRIPTION OF THE SEVERAL VIEWS OF THE DRAWINGS

Reference will now be made to the accompanying drawings, which are not necessarily drawn to scale, and wherein:

Figure 1 shows a schematic block diagram of a system for monitoring access to a transport container, according to one embodiment of the present invention;

Figure 2 shows a schematic block diagram of an interface unit, according to one embodiment of the present invention;

Figure 2A shows a schematic block diagram of an interface unit, according to another embodiment of the present invention;

Figure 3 shows a schematic block diagram of a system for monitoring access to a transport container, according to another embodiment of the present invention;

Figure 4 shows a schematic block diagram of a programming unit, according to one embodiment of the present invention;

Figures 5A and 5B show a circuit diagram of the monitoring unit, according to one embodiment of the present invention;

Figures 6A and 6B show a flow diagram of the operations performed by the monitoring unit, according to one embodiment of the present invention;

Figure 7 shows a flow diagram of the operations performed by the monitoring unit, according to another embodiment of the present invention;

Figure 8 shows a flow diagram of the operations performed by a programming unit, according to one embodiment of the present invention; and

Figure 9 shows a flow diagram of the operations performed by a programming unit, according to another embodiment of the present invention.

DETAILED DESCRIPTION OF THE INVENTION

The present invention now will be described more fully hereinafter with reference to the accompanying drawings, in which some, but not all embodiments of the invention are shown. Indeed, this invention may be embodied in many different forms and should not be construed as limited to the embodiments set forth

herein; rather, these embodiments are provided so that this disclosure will satisfy applicable legal requirements. Like numbers refer to like elements throughout.

Referring to Figure 1, there is illustrated a system **11** for monitoring access to a transport container, according to one embodiment of the present invention. The system **11** includes a monitoring unit **10** secured to the transport container (not shown) and at least one sensor **12** for detecting access to the transport container. Each sensor **12** is in operable communication with the monitoring unit **10** through suitable wiring or using wireless communications. The monitoring unit **10** and each sensor **12** are operably mounted or secured to the transport container so as to prevent damage to the monitoring unit and/or the sensor(s) from the cargo or products stored within the container and to ensure that the sensor(s) can detect access to the transport container. Preferably, the monitoring unit **10** is inconspicuously located within the transport container, such as a location that is not readily visible. The sensors **12** can include, but are not limited to, optical sensors (such as infrared motion sensors, pyroelectic sensors, and light-intensity sensors), temperature sensors, sound sensors, vibration sensors, magnetic switches, radiation sensors, location sensors (such as a global positioning system), as well as other sensors that are sensitive to chemical, temperature, strain, electrical, magnetic, motion, etc. changes associated with the transport container or with the environment within the interior of the container.

The system **11** includes an interface unit **14** in operable communication with the monitoring unit **10**. The interface unit **14** and the monitoring unit **10** preferably communicate through wireless communications, including without limitation, radio-frequency communications, low-earth orbiting satellite communications (such as used by Orbcomm), geosynchronous satellite communications, mobile telephony, etc. The system **11** also includes one or more data keys **15** that are configured to communicate with the monitoring unit **10** and the interface unit **14**. The data keys **15** are capable of being configured as an activation key **16** and/or a deactivation key **18**. The activation key **16** is configured to activate the monitoring unit **10** so that the monitoring unit begins to monitor access to the transport container. The deactivation key **18** is configured to

deactivate the monitoring unit **10**. Each data key **15** includes a data repository **15a**, which comprises computer-readable memory.

Referring to Figure 2, there is illustrated the interface unit **14**, according to one embodiment of the present invention. The interface unit **14** includes one or more programming units **20** that are configured to communicate with the monitoring unit **12**. For example, each programming unit **20** can comprise a mobile, handheld device that includes an appropriate housing (not shown) and power supply **26**, such as batteries. Each programming unit **20** preferably is configured to communicate with the monitoring unit **10** using wireless communications, such as radio-frequency communications. According to one embodiment, each programming unit **20** communicates with the monitoring unit **20** at a radio frequency of approximately 433MHz. In another embodiment, each programming unit **20** is configured to communicate with the monitoring unit **20** at two or more different radio frequencies. Advantageously, this latter embodiment allows the system **11** to function in countries having different radio-frequency spectrum allocations or requirements.

Each programming unit **20** of the interface unit **14** is structured to configure a data key **15** into an activation key **16** by communicating to the data key an activation code and data corresponding to the cargo within the transport container. For example, for a transport container being transported by ship, this data can include the cargo manifest, the name of the vessel, the nationality of the vessel, the name of the master, the port of loading, the port of discharge, the date of departure from port of loading, the time of departure from port of loading, the voyage number, etc. Analogous data can be compiled for other types of transport containers, such as trailers, railcars, transport containers traveling via air, etc. The activation code preferably comprises a unique encrypted code associated with the operator of the interface unit **14** (*i.e.*, the programming unit **20**) configuring the data key **15** as an activation key **16**. For example, the activation code can be generated based at least in part on the operator's username and password. As illustrated in Figures 1 and 2, the activation key **16** is configured to communicate the activation code and data corresponding to the transport container to the corresponding monitoring unit **10**. Advantageously, the activation code allows the

transport company to identify the individual responsible for securing the transport container and activating the monitoring unit **10**, which places accountability on the individual thereby insuring that the individual will give proper attention to the task of confirming the contents of the transport container prior to securing the container and activating the monitoring unit.

Each programming unit **20** of the interface unit **14** is also structured to configure a data key **15** into a deactivation key **18** by communicating to the data key a deactivation code. The deactivation code preferably comprises a unique encrypted code associated with the operator of the interface unit **14** (*i.e.*, the programming unit **20**) configuring the data key **15** as a deactivation key **18**. For example, the deactivation code can be generated based at least in part on the operator's username and password. As illustrated in Figures 1 and 2, the deactivation key **18** is configured to communicate the deactivation code to the corresponding monitoring unit **10**. Advantageously, the deactivation code allows the transport company to identify the individual responsible for opening the transport container and deactivating the monitoring unit **10**, which places accountability on the individual thereby insuring that the individual will give proper attention to the task of confirming the contents of the transport container subsequent to deactivating the monitoring unit.

The interface unit **14** also includes a controller **22**, such as a processor or computer operating under software control. The controller **22** is in operable communication with each programming unit **20** through a wired and/or wireless communications connection, such as a local area network, a wide area network, the Internet, satellite, modular telephony, etc., so that the programming unit can communicate to the controller **22** pertinent data, such as the activation codes, deactivation codes, data corresponding to the transport container and/or data corresponding to incidents of access to the transport container. The data corresponding to the incidents of access will depend upon the type of sensor(s) **12** used in connection with the monitoring unit **10**, but generally will include the date, time, and duration of the access incident, as well as the location of the transport container at the time of the access incident. The controller **22** preferably includes a data repository **24** comprising computer-readable memory to store the data

communicated to the controller **22** by the programming unit **20**. The controller **22** can be configured to communicate via a wired and/or wireless communications connection, such as a local area network, a wide area network, the Internet, satellite, modular telephony, etc., all or a portion of the data received from the programming unit **20** to interested parties, such as the owner of the cargo in the transport container, governmental agencies (such as the U.S. Department of Homeland Security, Bureau of Customs and Border Protection, or a equivalent foreign agency, etc.). The provision of this data in a timely fashion to the requisite governmental authorities can facilitate the transport container passing local customs efficiently and in a reasonable amount of time.

Optionally, as illustrated in Figure 2A, the monitoring unit **10** can be configured to communicate directly with the controller **22** through a satellite communications connection. While a geosynchronous satellite or satellite network may be used, a low-earth satellite network (such as used by Orbcomm) is preferred since such networks do not generally entail the problems associated with geosynchronous satellites, such as line-of-site communication and high power requirements. According to this embodiment, the monitoring unit **10** includes a transmitter or other communications device **27** that is configured to communicate data corresponding to any access incidents to a relay unit **28** (such as using radio-frequency communications) that is in turn configured to communicate the data to a satellite or satellite network **30**. The satellite or satellite network **30** communicates the data to a satellite ground-station **32**, which in turn communicates the data to the controller **22** via a wired and/or wireless communications connection. Alternatively, the satellite ground-station **32** can communicate the data to another controller (not shown) which then communicates the data to the controller **22** via a wired and/or wireless communications connection.

Referring to Figures 3 and 5, there is illustrated a system **31** for monitoring access to a transport container, according to one embodiment of the present invention. The system **31** includes a monitoring unit **10**. The monitoring unit **10** includes a housing **34** constructed of metal or a durable plastic material. The system **31** also includes sensors **12**, such as the light-sensitive resistor **36** and a door mounted magnetic switch **38**, for sensing when the doors of the transport

container are opened, or when light enters the transport container, of when the transport container is exposed to a direct heat source like a cutting torch, or the like. As discussed above, other types of sensors **12** can also be used.

As illustrated in Figure 3, the monitoring unit **10** includes a controller **40**, such as a processor operating under software control. The controller **40** includes a data repository **42** comprising computer-readable memory that is in operable communication with the controller **40**. The monitoring unit **10** further includes a power source **44**, such as a battery, for providing electrical power to the controller **40**. The monitoring unit **10** includes a data transfer interface **46** for communicating with the data keys **15** (*i.e.*, activation keys **16** and deactivation keys **18**). As discussed above, each data key **15** has computer-readable memory **15a** which is accessible by the data transfer interface **46** of the monitoring unit **10** through a plug-in connection, such as by a single-wire data serial communications protocol. The monitoring unit **10** includes a transmitter **48**, such as a radio-frequency transmitter, having an antenna **50** which is mountable on the inside or outside of the transport container. The frequency range of the transmitter **48** can depend upon available frequencies, which can depend upon the geographical location of the transport container. Preferably, the frequency range of the transmitter **48** is selected based upon the frequency range specified by the applicable radio-frequency identification authority. For example, in one embodiment, the frequency range is approximately 433MHz. According to other embodiments, the transmitter **48** is configured to communicate on two or more frequencies. The monitoring unit **10** further includes a receiver **52**, such as a low-frequency, radio-frequency receiver, having an antenna **54** which is also mounted on the inside or outside of the transport container. The controller **40**, data repository **42**, power supply **44**, transmitter **48**, and receiver **52** are preferably sealed within the housing **34** to protect the components.

Referring to Figures 5A and 5B, there is illustrated the internal circuit diagram of a monitoring unit **10**, according to one embodiment of the present invention. The controller **40** receives power from the power supply **44** via connector **82**. A light emitting diode (LED) indicator (not shown) is installed to be visible from inside the transport container and is connected via connector **80** to the

controller **40**. The transmitter **48** and its antenna **50** are shown connected to the controller **40**, with the activation receiver **52** (Figure 3) also connected via connector **80** to the controller **40**. Provision is made for four inputs to the analog or digital configurable input ports of the controller **40** via connector **84**. Connector **86** allows the connection of the controller **40** to a programming station, to program the controller **40** with executable code.

Referring to Figure 4, there is illustrated a handheld programming unit **20**, according to one embodiment of the present invention. The programming unit **20** includes a power supply **26**, such as a battery, for supplying power to the programming unit. The programming unit **20** further includes a liquid crystal display (LCD) **55** and a configuration interface **56** in the form of an RS232 serial interface through which the programming unit is connected to the controller **22** of the interface unit **14** (illustrated in Figure 2). The programming unit **20** also includes a controller **57**, such as a processor operating under software control, and a data transfer interface **60** which is connectable to the data key **15** so that the data key is in operable communication with the programming unit. The programming unit **20** further includes a data repository **21** comprising computer-readable memory in operable communication with the controller **57**. The programming unit **20** further includes a receiver **62**, such as a radio-frequency receiver, matched to the transmitter **48** of the monitoring unit **10**. The receiver **62** includes an antenna **64** which generally needs to be located within the line of sight of the transport container. The programming unit **20** further includes a transmitter **66**, such as a low-frequency, radio-frequency transmitter, having an antenna **68** which generally needs to be located in close proximity with the antenna **54** of the receiver **52** of the monitoring unit **10**.

Referring to Figures 6A and 6B, there are illustrated the operations performed by the controller **40** of the monitoring unit **10**, according to one embodiment of the present invention. The controller **40** is normally in a sleep mode, see Block **100**, which is a reduced activity power saving mode. This mode saves power consumption from the power supply **44**, thereby extending the life of the power supply. At predetermined time intervals, such as once every two seconds, the controller **40** wakes up, see Block **102**, and checks the data transfer

interface **46** for the presence of a data key **15**. If a data key **15** is detected, see Block **104**, the memory of the data key **15** is checked to determine which type of key it is, see Block **106**. Depending on the type of information stored on the data key **15**, the data key can either be configured as an activation key **16** or a de-activation key **18**, or it can be of unknown origin. If the data key **15** is a deactivation key **18**, see Block **108**, the data that is stored in the data repository **42** of the monitoring unit **10** is transferred to the deactivation key **18**. The data transferred to the deactivation key **18** can include the activation code, the deactivation code, data corresponding to the transport container, and/or data corresponding to the incidents of access to the transport container. According to one embodiment, this data can be downloaded or transferred only once. The status of the controller **40** of the monitoring unit **10** is set to "deactivated" and the LED which is connected via connector **80** (see Figure 5A) indicates that the monitoring unit **10** is deactivated.

If the data key **15** is not a deactivation key **18**, the data key is checked to determine if the data key is an activation key **16**. See Block **110**. If the data key **15** is an activation key **16**, the data corresponding to the transport container and the activation code is transferred from the activation key **16** to the data repository **42** of the monitoring unit **10**. See Block **112**. As discussed above, the activation code comprises a unique code that is generated by the programming unit **20**. Preferably, the date and time of activation is stored in the data repository **42** of the monitoring unit **10** by the controller **40**. See Block **112**. In one embodiment, the LED port **80** is activated to flash the LED (not shown) with a two second on-off duty cycle, indicating that the monitoring unit **10** has been activated. See Block **112**. The controller **40** then waits for the container door (not shown) to be closed, for example, as monitored by the magnetic switch **38** (Figure 3), before the activation cycle is completed. If the data key **15** is not an activation key **16**, see Block **114**, the controller **40** assumes that the data key is unconfigured and the LED is activated accordingly via connector **80**, see Block **116**. After completing each subroutine in **108**, **112** and **116**, operation of the controller **40** returns to **118**.

If a data key **15** is not inserted into the data transfer interface **46** of the monitoring unit **10**, then the status of the monitoring unit is checked by the

controller **40**. See Block **118**. If the monitoring unit **10** is not activated, the controller **40** goes back to sleep. See Block **100**. If the monitoring unit **10** is activated, the controller **40** queries or checks if the activation receiver **52** received an activation signal from the transmitter **66** of the programming unit **20** of the interface unit **14**. If the activation receiver **52** received an activation signal, see Block **120**, the controller **40** instructs the transmitter **48** to transmit the data from the data repository **42** corresponding to the access incidents to the receiver **62** of the programming unit **20** or, according to the embodiment illustrated in Figure 2A, instructs the transmitter **27** to transmit the data to the relay unit **28**, as discussed above. See Block **122**. The controller **40** checks the sensors **12**. See Block **124**. If the sensors **12** indicate an access incident has occurred, see Block **126**, the access incident is stored by the controller **40** in the data repository **42**, including data corresponding to the time and date at which the access incident started and the time and date at which the access incident ended. See Block **128**. Thereafter, the controller **40** goes back to sleep. See Block **100**.

Referring to Figure 7, there is illustrated a method for monitoring a transport container, according to another embodiment of the invention. The method includes identifying an activation key. See Block **130**. An activation code and data corresponding to the contents of the transport container are received from the activation key. See Block **132**. At least one sensor structured to detect incidents of access to the transport container is activated. See Block **134**. Data corresponding to the access incidents is received from the at least one sensor. See Block **136**. The data corresponding to access incidents is stored in a data repository. See Block **138**. The data corresponding to the access incidents is communicated to an interface unit. See Block **140**. A deactivation key is identified. See Block **142**. A deactivation code is received from the deactivation key. See Block **144**. Data corresponding to the access incidents and data corresponding to the contents of the transport container is communicated to the deactivation key. See Block **146**.

Referring to Figure 8, there is illustrated the operation of the programming unit **20**, according to one embodiment of the present invention. When the programming unit **20** is switched on, controller **57** instructs the LCD **55** to display

the time, date and system data. See Block **200**. If the controller **57** detects a connection to a controller **22** through the configuration interface **56**, the controller **57** establishes a connection link therewith. See Block **202**. The data corresponding to the transport container is then transferred from the data repository **24** associated with the controller **22** to the data repository **21** of the programming unit **20**. See Block **204**. Thereafter, the user depresses the download data button **70** of the programming unit **20**, see Block **206**, to thereby communicate or transfer the data corresponding to the transport container from the data repository **21** of the programming unit to the data transfer interface **60**, which transfers the data to the data key **15** (and thereby configures the data key **15** into an activation key **16**). See Block **208**. In addition to the data corresponding to the transport container, the programming unit **20** also communicates or transfers to the activation key **16** the activation code, which is uniquely associated with the person entering the data on the programming unit, such as through the user's user name and/or password. See Block **208**.

To access the data corresponding to the access incidents, the user of the programming unit **20** depresses the receive data button **72** of the programming unit to transmit an activation signal from the transmitter **66** of the programming unit to the activation receiver **52** of the monitoring unit **10**. See Block **210**. Upon receipt of the activation signal by the receiver **52**, which is communicated to the controller **40** of the monitoring unit **10**, the controller **40** instructs the data repository **42** to communicate or transfer the data corresponding to access incidents from the data repository **42** to the transmitter **48** of the monitoring unit, which in turn communicates or transmits the data corresponding to the access incidents to the receiver **62** of the programming unit **20**. See Block **212**.

According to one embodiment, the controller **57** queries or checks the configuration interface **56** to determine if a "data request command" has been received from the controller **22**. See Block **214**. If a "data request command" was received from the controller **22**, the data key **15** is programmed with the data received from the controller **22**. See Block **216**. The data can include the data corresponding to the transport container, such as the container ID, manifest number and destination port number, etc.

According to one embodiment, the controller **57** queries or checks the configuration interface **56** to determine if a "set date and time command" has been received from the controller **22**. See Block **218**. If a "set date and time command" was received from the controller 22, the programming unit **20** is programmed with the current date and time. See Block **220**.

According to another embodiment of the present invention, there is illustrated in Figure 9 a method for activating and deactivating a monitoring unit for monitoring access to a transport container. The method comprises communicating an activation code and data corresponding to the contents of the transport container to an activation key. See Block **240**. An activation signal is communicated to a monitoring unit. See Block **242**. Data corresponding to the access incidents is received from the monitoring unit by an interface unit. See Block **244**. According to another embodiment, a deactivation code is communicated to a deactivation key. See Block **246**. Thereafter, data corresponding to the contents of the transport container and the data corresponding to the access incidents is received by the deactivation key. See Block **248**.

In use, after installation of the monitoring unit **10**, transport containers can be loaded with freight or cargo. The freight manifest is completed according to the freight or cargo that is to be transported. Data corresponding to the transport container, such as the freight manifest, destination, etc. is inputted (either manually or electronically) to the controller **22** and stored in the data repository **24**. The programming unit **20** is plugged into an RS232 port of the controller **22**. Upon detection of the controller **22**, the programming unit **20** transfers the data corresponding to the transport container and stores the data in the data repository **21**. The programming unit **20** generates an activation code which is uniquely associated with the operator of the programming unit through a user name and password. According to one embodiment, the activation code and data corresponding to the transport container is combined. A data key **15** is connected to the data transfer interface **60** of the programming unit **20** and the download data button **70** is pressed causing the data transfer interface **60** to transfer the data to the data key **15**. The data key **15** is now configured as an activation key **16**.

The activation key **16** is connected to the data transfer interface **46** of the monitoring unit **10**, which causes the monitoring unit to transfer the activation code and data corresponding to the transport container. The operator is allowed a certain period of time, such as fifteen (15) seconds, to close and secure the container doors, which will cause the container monitoring unit **10** to go into its activated mode. From the moment that the container doors are closed and secured, the monitoring cycle is started and any violations sensed by sensor(s) **12** will be stored with a time and date stamp in the data repository **42** of the monitoring unit **10**, as well as any other pertinent information that may be desired, such as the corresponding geographic location, duration, etc. Therefore, any attempt to interfere or change the freight contents or otherwise obtain access to the transport container in which the monitoring unit **10** is installed and in its activated mode will trigger an access incident to be stored.

At the destination, after offloading the transport container from a ship, truck, aircraft or other vehicle, the transmitter **66** of the programming unit **20** generates a low-frequency, radio-frequency transmission which when received by the activation receiver **52** of the monitoring unit **10** causes the monitoring unit to enter a data download or transfer mode. The monitoring unit **10** transmits data corresponding to any access incidents via the transmitter **48**. The transmissions are received by the receiver **62** of the programming unit **20**. If any access incidents are recorded, the transport container can be placed in a quarantine area and can be thoroughly searched. At the destination, the operator connects another data key **15** to the data transfer interface **60** of the programming unit **20** to configure the data key as a deactivation key **18**. More specifically, data transfer interface **60** of the programming unit **20** transmits to the data key **15** a deactivation code that is uniquely associated with the operator of the programming unit **20**, such as by user name and/or password. The container doors are opened and within a certain period of time, such as fifteen (15) seconds, the deactivation key **18** is pressed against the data transfer interface **46** of the monitoring unit **10**. The controller **40** of the monitoring unit **10** identifies the deactivation key **18** from the deactivation code. After the controller **40** stores the deactivation code of the operator in the data repository **42**, the controller **40** deactivates the monitoring cycle. Comprehensive

data corresponding to any stored access incidents, the data corresponding to the transport container, the activation code and deactivation code are then communicated or transferred by the controller **40** from the data repository **42** to the deactivation key **18** via the data transfer interface **46**. As discussed above, the data corresponding to any stored access incidents, the data corresponding to the transport container, the activation code and deactivation code can in turn be transferred to the programming unit **20**.

At the destination, the programming unit **20** can be connected to the controller **22** wherein the data corresponding to any stored access incidents, the data corresponding to the transport container (including the time of activation and deactivation of the monitoring unit), the activation code (operator identity) and deactivation code (operator identity) can be transferred to the data repository **24** and disseminated to interested parties. The combination of this data will give comprehensive data on the transport container while it was being transported.

Figures 1, 2, 2A, 3, 4, 6, 7, 8, and 9 are block diagrams, flowcharts and control flow illustrations of methods, systems and program products according to the invention. It will be understood that each block or step of the block diagrams, flowcharts and control flow illustrations, and combinations of blocks in the block diagrams, flowcharts and control flow illustrations, can be implemented by computer program instructions. These computer program instructions may be loaded onto, or otherwise executable by, a computer or other programmable apparatus to produce a machine, such that the instructions which execute on the computer or other programmable apparatus create means or devices for implementing the functions specified in the block diagrams, flowcharts or control flow block(s) or step(s). These computer program instructions may also be stored in a computer-readable memory that can direct a computer or other programmable apparatus to function in a particular manner, such that the instructions stored in the computer-readable memory produce an article of manufacture, including instruction means or devices which implement the functions specified in the block diagrams, flowcharts or control flow block(s) or step(s). The computer program instructions may also be loaded onto a computer or other programmable apparatus to cause a series of operational steps to be performed on the computer or other

programmable apparatus to produce a computer implemented process such that the instructions which execute on the computer or other programmable apparatus provide steps for implementing the functions specified in the block diagrams, flowcharts or control flow block(s) or step(s).

Accordingly, blocks or steps of the block diagrams, flowcharts or control flow illustrations support combinations of means or devices for performing the specified functions, combinations of steps for performing the specified functions and program instruction means or devices for performing the specified functions. It will also be understood that each block or step of the block diagrams, flowcharts or control flow illustrations, and combinations of blocks or steps in the block diagrams, flowcharts or control flow illustrations, can be implemented by special purpose hardware-based computer systems which perform the specified functions or steps, or combinations of special purpose hardware and computer instructions.

Many modifications and other embodiments of the inventions set forth herein will come to mind to one skilled in the art to which these inventions pertain having the benefit of the teachings presented in the foregoing descriptions and the associated drawings. Therefore, it is to be understood that the inventions are not to be limited to the specific embodiments disclosed and that modifications and other embodiments are intended to be included within the scope of the appended claims. Although specific terms are employed herein, they are used in a generic and descriptive sense only and not for purposes of limitation.

THAT WHICH IS CLAIMED:

1. A system for monitoring access to a transport container, comprising:

a monitoring unit secured to the transport container;

at least one sensor in operable communication with said monitoring unit, said at least one sensor being structured to detect incidents of access to the transport container and to communicate data corresponding to the access incidents to said monitoring unit;

an interface unit being configured to communicate with said monitoring unit;

at least one data key configured to communicate with said monitoring unit, said at least one data key is capable of being configured as at least one of an activation key and a deactivation key, wherein said activation key is configured to activate said monitoring unit so that said monitoring unit begins to monitor access to the transport container, said deactivation key is configured to deactivate said monitoring unit; and

wherein said monitoring unit is configured to communicate data corresponding to the access incidents to said interface unit.

2. A system according to Claim 1, wherein said monitoring unit comprises:

a controller, said controller being configured to communicate with said at least one sensor, said activation key and said deactivation key;

a power supply in operable communication with said controller;

a data repository in operable communication with said controller and being structured to store the data corresponding to access incidents;

a transmitter in operable communication with said controller, said transmitter being configured to communicate data corresponding to the access incidents to said interface unit; and

a receiver in operable communication with said controller, said receiver being configured to receive communications from said interface unit.

3. A system according to Claim 1, wherein said interface unit is configured to communicate to said activation key an activation code and data corresponding to the contents of the transport container, and wherein said activation key is configured to communicate the activation code and data corresponding to the contents of the transport container to said monitoring unit.

4. A system according to Claim 3, wherein the activation code comprises data corresponding to the operator of said interface unit communicating with said activation key.

5. A system according to Claim 1, wherein said interface unit is configured to communicate to said deactivation key a deactivation code, and wherein said deactivation key is configured to communicate the deactivation code to said monitoring unit.

6. A system according to Claim 5, wherein the deactivation code comprises data corresponding to the operator of said interface unit communicating with said deactivation key.

7. A system according to Claim 5, wherein said monitoring unit is configured to communicate to said deactivation key the data corresponding to the contents of the transport container and the data corresponding to the access incidents.

8. A system according to Claim 7, wherein said deactivation key is configured to communicate to said interface unit the data corresponding to the contents of the transport container and the data corresponding to the access incidents.

9. A system according to Claim 7, wherein said monitoring unit is configured to communicate to said deactivation key data corresponding to the operator of said interface unit communicating with said activation key and data corresponding to the operator of said interface unit communicating with said deactivation key, and wherein said deactivation key is configured to communicate to said interface unit the data corresponding to the contents of the transport container, data corresponding to the access incidents, data corresponding to the operator of said interface unit communicating with said activation key, and data corresponding to the operator of said interface unit communicating with said deactivation key.

10. A system according to Claim 1 wherein said monitoring unit is configured to communicate the data corresponding to the access incidents to said interface unit through wireless communication.

11. A system according to Claim 1 wherein said monitoring unit is configured to communicate the data corresponding to the access incidents to said interface unit through low-earth orbiting satellite communication.

12. A system according to Claim 1 wherein said interface unit comprises at least one programming unit and a second controller, said at least one programming unit being configured to communicate with said second controller.

13. A system according to Claim 1 wherein said at least one sensor comprises a sensor selected from the group consisting of an infrared motion sensor, an optical sensor, a temperature sensor, a sound sensor, a vibration sensor, a magnetic switch, and a radiation sensor.

14. A system for monitoring access to a transport container, comprising:

a monitoring unit secured to the transport container;

at least one sensor in operable communication with said monitoring unit, said at least one sensor being structured to detect incidents of access to the transport container and to communicate data corresponding to the incidents to said monitoring unit; and

at least one data key configured to communicate with said monitoring unit, said at least data key is capable of being configured as at least one of an activation key and a deactivation key, wherein said activation key is configured to activate said monitoring unit so that said monitoring unit begins to monitor access to the transport container, said deactivation key is configured to deactivate said monitoring unit; and

wherein said monitoring unit is configured to communicate data corresponding to the access incidents to said deactivation key.

15. A system according to Claim 14, wherein said monitoring unit comprises:

a controller, said controller being configured to communicate with said at least one sensor, said activation key and said deactivation key;

a power supply in operable communication with said controller; and

a data repository in operable communication with said controller and being structured to store the data corresponding to access incidents.

16. A system according to Claim 14, wherein said activation key comprises a data repository, said data repository storing an activation code and data corresponding to the contents of the transport container, and wherein said activation key is configured to communicate the activation code and data corresponding to the contents of the transport container to said monitoring unit.

17. A system according to Claim 14, wherein said deactivation key comprises a data repository, said data repository storing a deactivation code.

18. A system according to Claim 14, wherein said monitoring unit is structured to communicate to said deactivation key the data corresponding to the contents of the transport container.

19. A system according to Claim 14 wherein said at least one sensor comprises a sensor selected from the group consisting of an infrared motion sensor, an optical sensor, a temperature sensor, a sound sensor, a vibration sensor, a magnetic switch, and a radiation sensor.

20. A computer program product for monitoring access to a transport container, the computer program product comprising a computer-readable storage medium having computer-readable program code portions stored therein, the computer-readable program portions comprising:

an executable portion for identifying an activation key, said executable portion activates at least one sensor structured to detect incidents of access to the transport container, said executable portion receives data corresponding to the access incidents from the at least one sensor, and wherein said executable portion communicates the data corresponding to the access incidents to an interface unit.

21. A computer program product according to Claim 20 wherein said executable portion stores the data corresponding to access incidents in a data repository.

22. A computer program product according to Claim 20 wherein said executable portion receives an activation code and data corresponding to the contents of the transport container from the activation key.

23. A computer program product according to Claim 20 wherein said executable portion identifies a deactivation key, and wherein said executable portion communicates the data corresponding to the access incidents to the deactivation key.

24. A computer program product according to Claim 23 wherein said executable portion receives a deactivation code from the deactivation key.

25. A computer program product according to Claim 24 wherein said executable portion communicates to the deactivation key the data corresponding to the contents of the transport container.

26. A computer program product for activating and deactivating a monitoring unit for monitoring access to a transport container, the computer program product comprising a computer-readable storage medium having computer-readable program code portions stored therein, the computer-readable program portions comprising:

an executable portion for communicating an activation code and data corresponding to the contents of the transport container to an activation key, said executable portion communicating an activation signal to a monitoring unit, and wherein said executable portion receives data corresponding to the access incidents from the monitoring unit.

27. A computer program product according to Claim 26 wherein said executable portion communicates a deactivation code to a deactivation key, and wherein said executable portion receives data corresponding to the contents of the transport container and the data corresponding to the access incidents.

28. A method for monitoring access to a transport container, comprising:

identifying an activation key;

activating at least one sensor structured to detect incidents of access to the transport container;

receiving data corresponding to the access incidents from the at least one sensor; and

communicating the data corresponding to the access incidents to an interface unit.

29. A method according to Claim 28 further comprising storing the data corresponding to access incidents in a data repository.

30. A method according to Claim 28 further comprising receiving an activation code and data corresponding to the contents of the transport container from the activation key.

31. A method according to Claim 28 further comprising identifying a deactivation key and, subsequent to said second identifying step, communicating the data corresponding to the access incidents to the deactivation key.

32. A method according to Claim 31 wherein said second identifying step comprises receiving a deactivation code from the deactivation key.

33. A method according to Claim 32 further comprising communicating to the deactivation key the data corresponding to the contents of the transport container.

34. A method for activating and deactivating a monitoring unit for monitoring access to a transport container, comprising:

communicating an activation code and data corresponding to the contents of the transport container to an activation key;

communicating an activation signal to a monitoring unit; and

receiving data corresponding to the access incidents from the monitoring unit.

35. A method according to Claim 34 further comprising communicating a deactivation code to a deactivation key and, subsequent to said third communicating step, receiving data corresponding to the contents of the transport container and the data corresponding to the access incidents.

ABSTRACT OF THE DISCLOSURE

The present invention provides a system for monitoring access to a transport container. The system includes a monitoring unit secured to the transport container and at least one sensor in operable communication with the monitoring unit. The sensor is structured to detect incidents of access to the transport container and to communicate data corresponding to the incidents to the monitoring unit. The system includes at data key configured to communicate with the monitoring unit. The data key is capable of being configured as an activation key and/or a deactivation key. The activation key is configured to activate the monitoring unit so that the monitoring unit begins to monitor access to the transport container. The deactivation key is configured to deactivate the monitoring unit. The monitoring unit is configured to communicate data corresponding to the access incidents to the deactivation key.

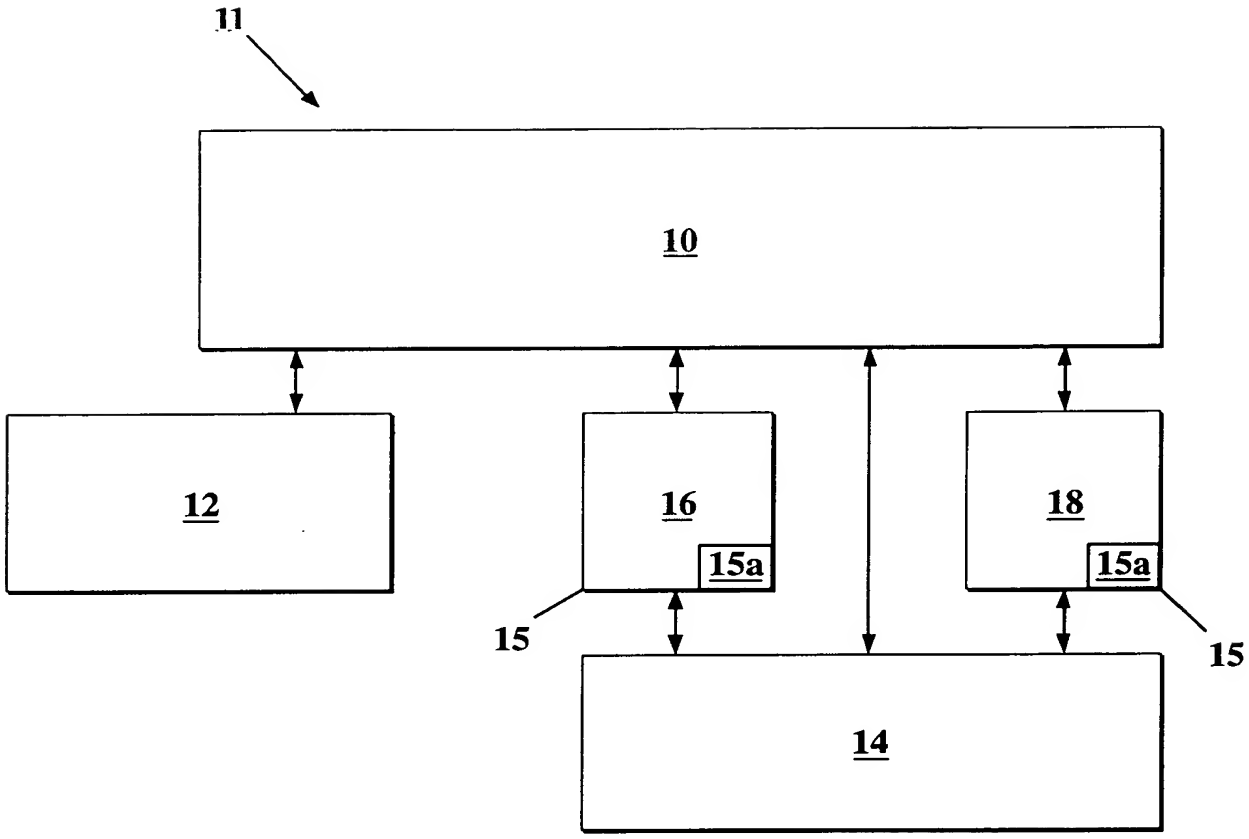

FIG. 1

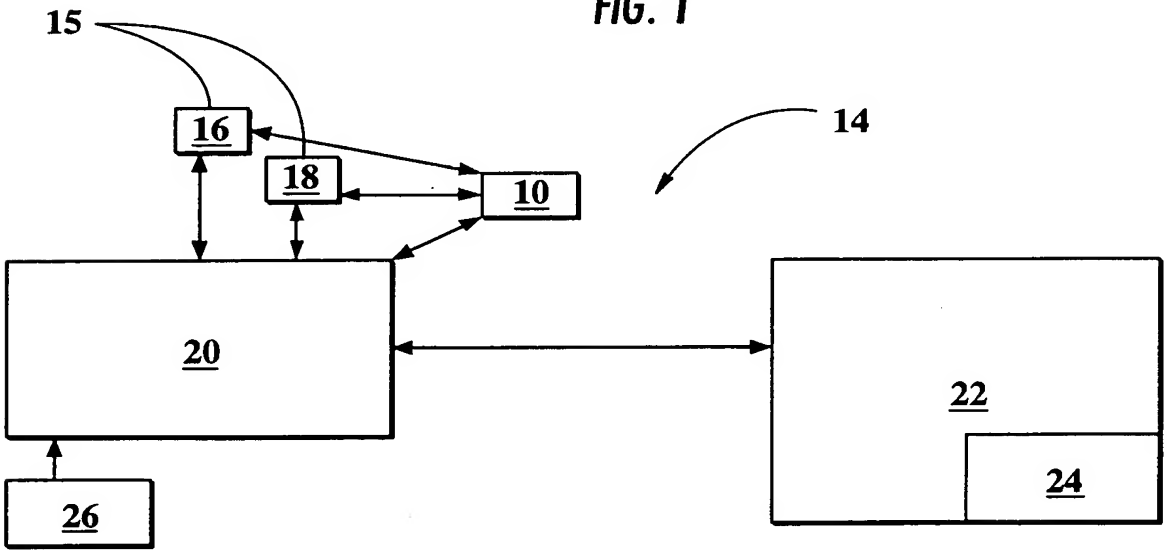

FIG. 2

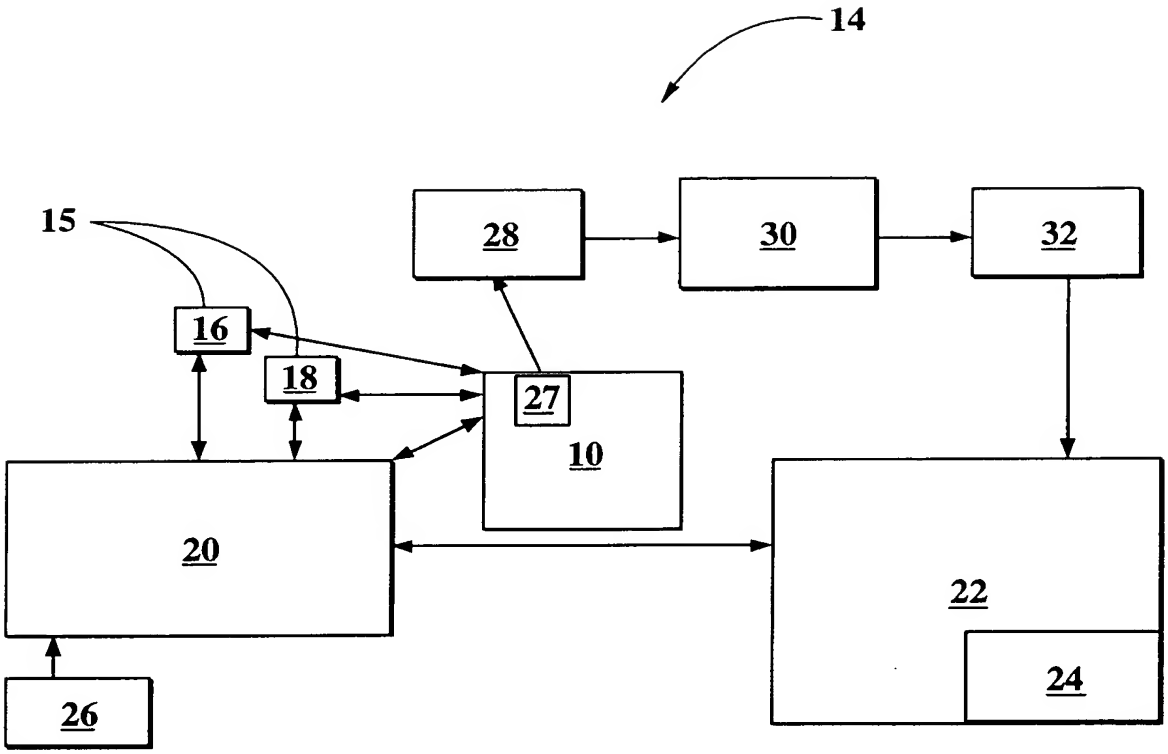

FIG. 2A

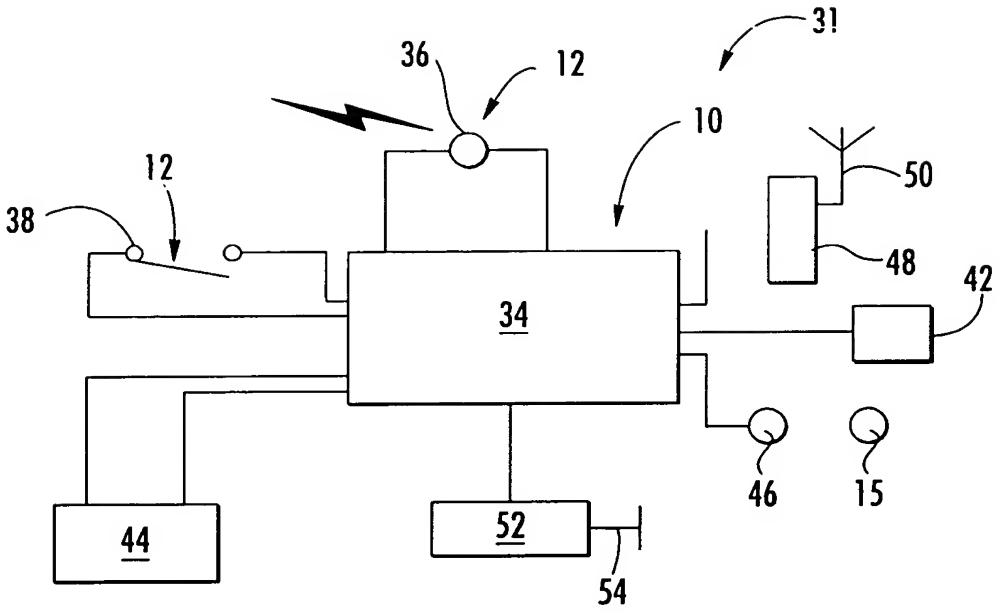
31
36
12
10
12
38
50
48
42
34
46
15
44
52
54

FIG. 3

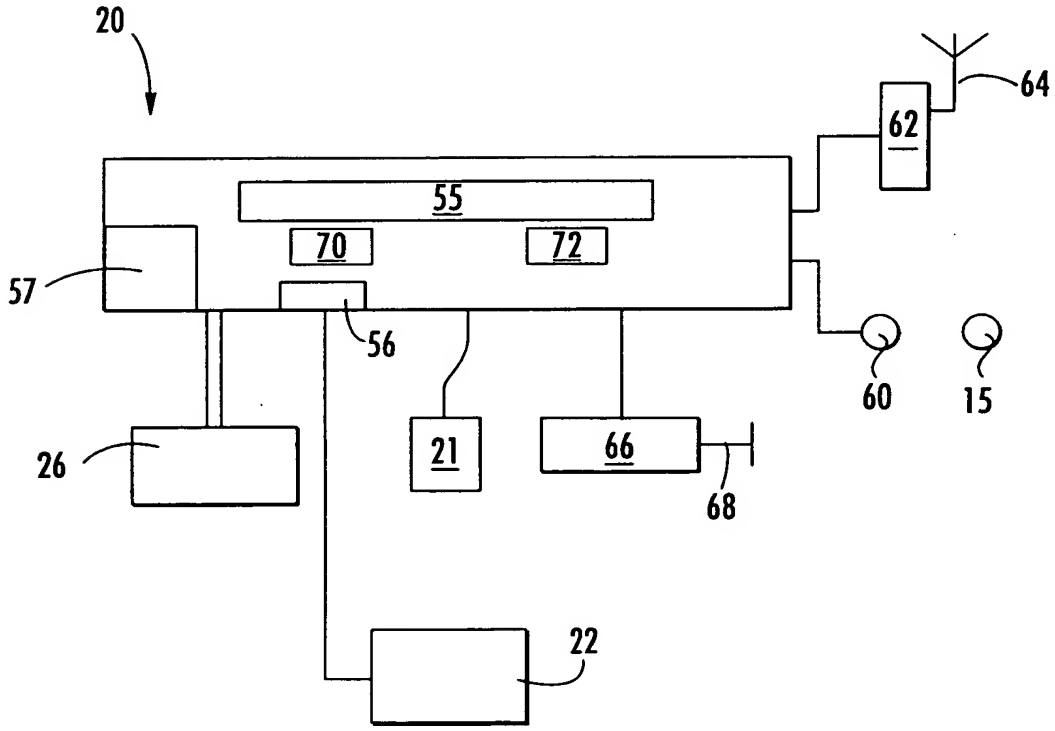
20
64
62
55
70
72
57
56
60
15
26
21
66
68
22

FIG. 4

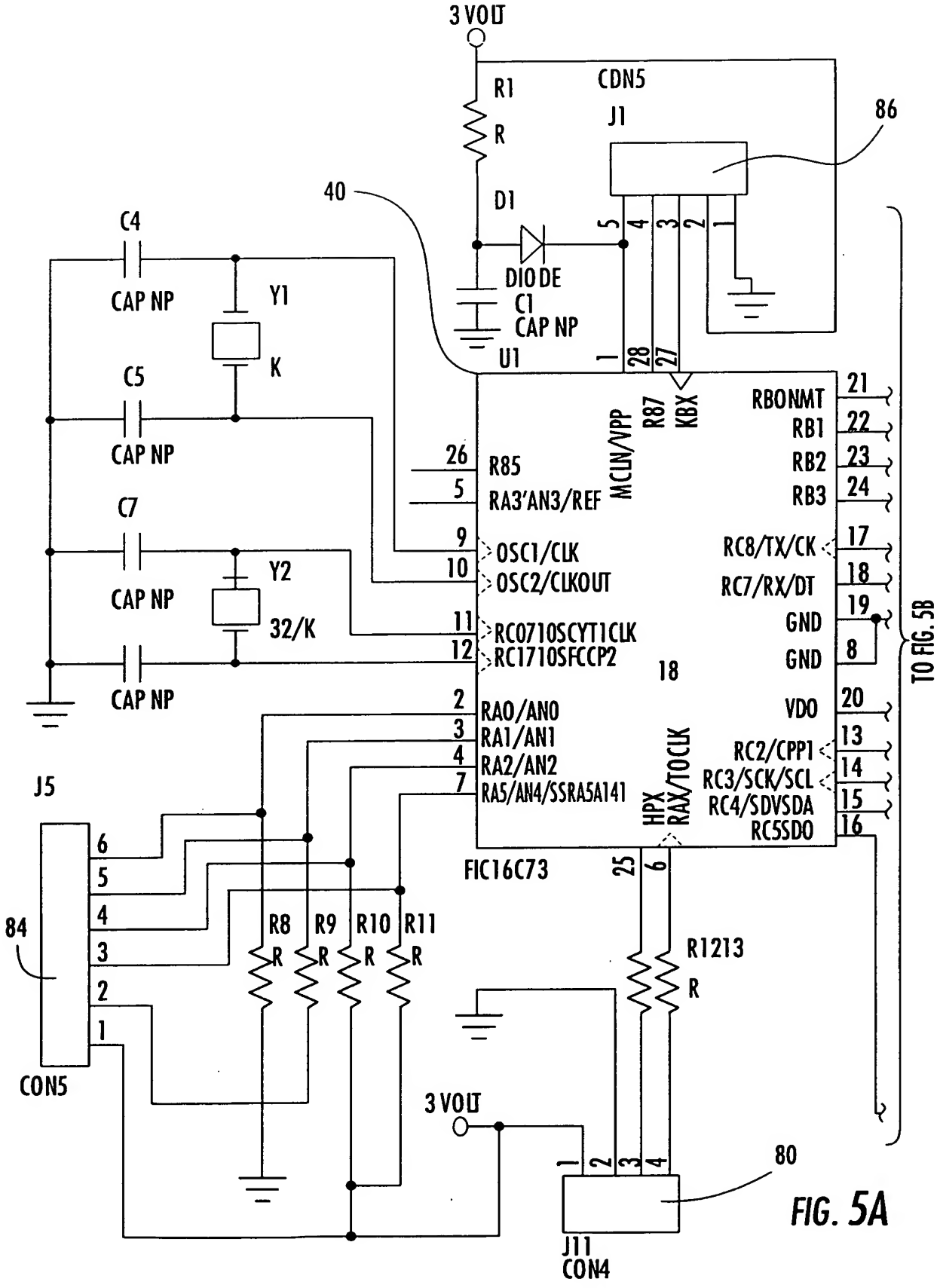
3 VOLT
R1
R
D1
DIODE
C1
CAP NP
CDN5
J1
86
40
U1
C4
CAP NP
Y1
K
C5
CAP NP
C7
CAP NP
Y2
32/K
CAP NP
MCLN/VPP
R87
KBX
R85
RA3'AN3/REF
OSC1/CLK
OSC2/CLKOUT
RC0710SCYT1CLK
RC1710SFCCP2
RA0/AN0
RA1/AN1
RA2/AN2
RA5/AN4/SSRA5A141
HPX
RAX/TOCLK
FIC16C73
RBONMT
RB1
RB2
RB3
RC8/TX/CK
RC7/RX/DT
GND
GND
VDO
RC2/CPP1
RC3/SCK/SCL
RC4/SDVSDA
RC5SDO
18
TO FIG. 5B
J5
84
CON5
R8
R9
R10
R11
R
R1213
3 VOLT
80
J11
CON4

FIG. 5A

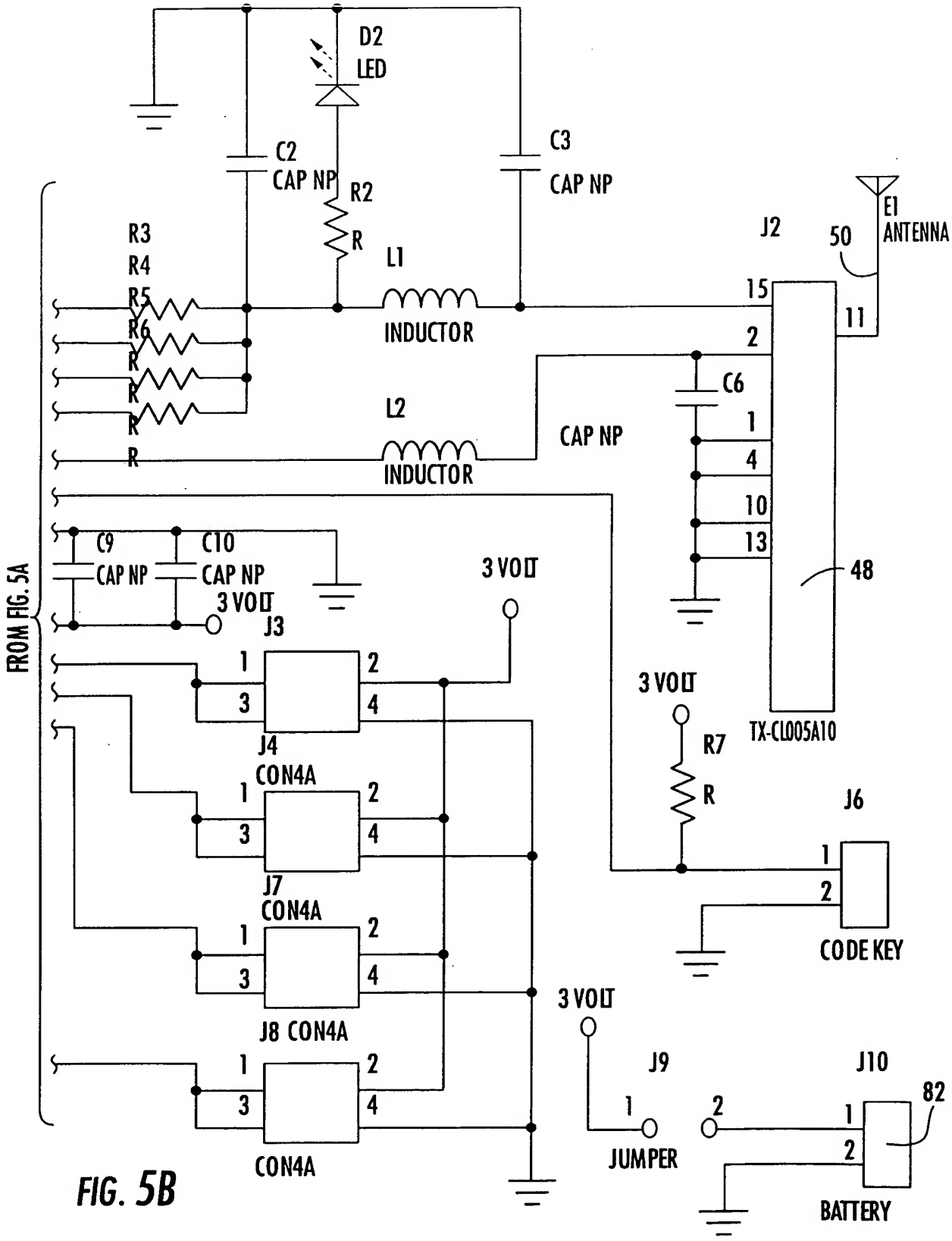
D2
LED
C2
CAP NP
C3
CAP NP
R2
R
R3
R4
R5
R6
R
R
R
R
L1
INDUCTOR
L2
INDUCTOR
CAP NP
J2
50
E1
ANTENNA
15
11
2
C6
1
4
10
13
48
TX-CL005A10
C9
CAP NP
C10
CAP NP
3 VOLT
3 VOLT
J3
FROM FIG. 5A
1
2
3
4
J4
CON4A
J7
CON4A
J8 CON4A
CON4A
3 VOLT
R7
R
J6
CODE KEY
3 VOLT
J9
JUMPER
J10
82
BATTERY

FIG. 5B

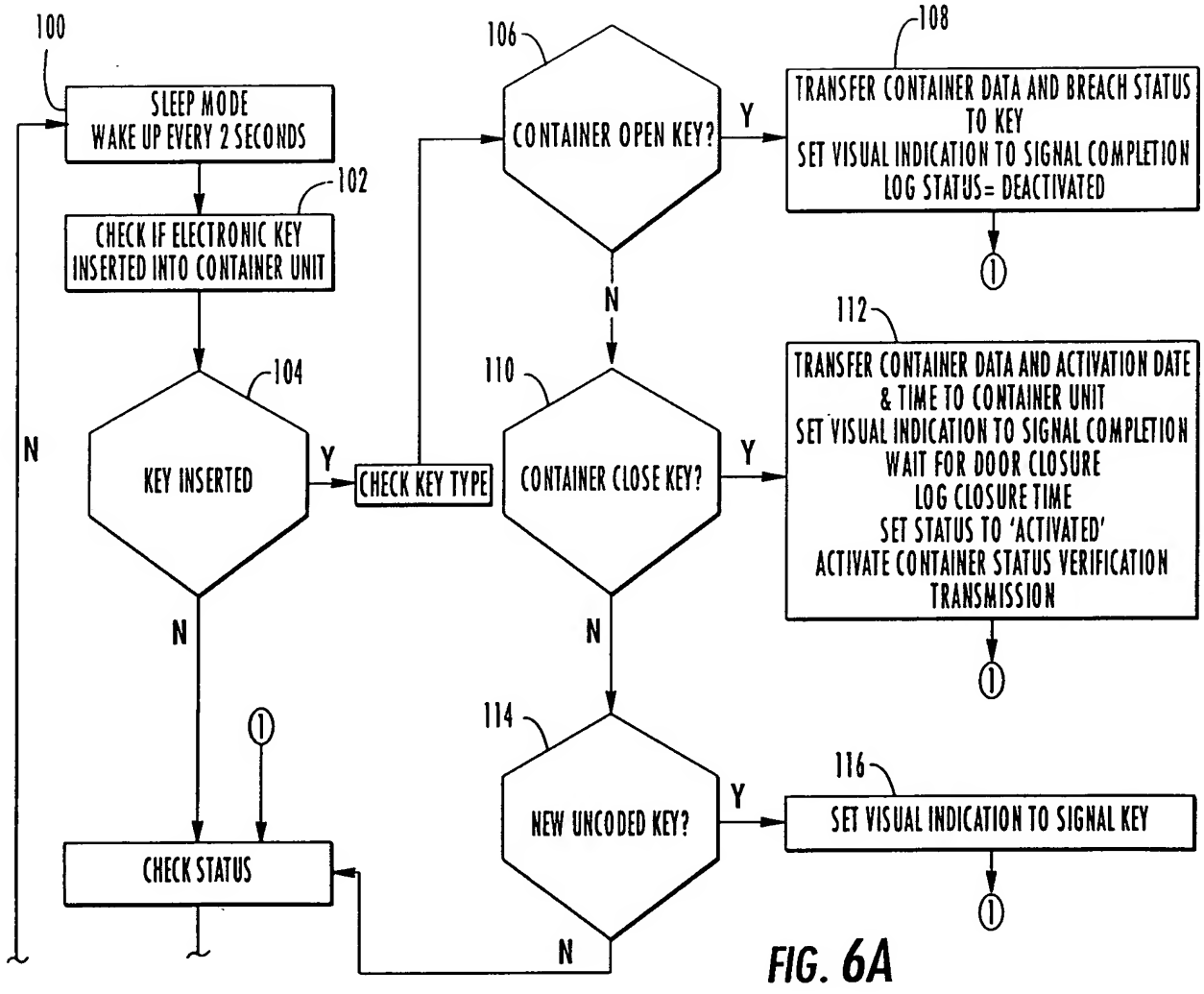

FIG. 6A

TO FIG. 6B

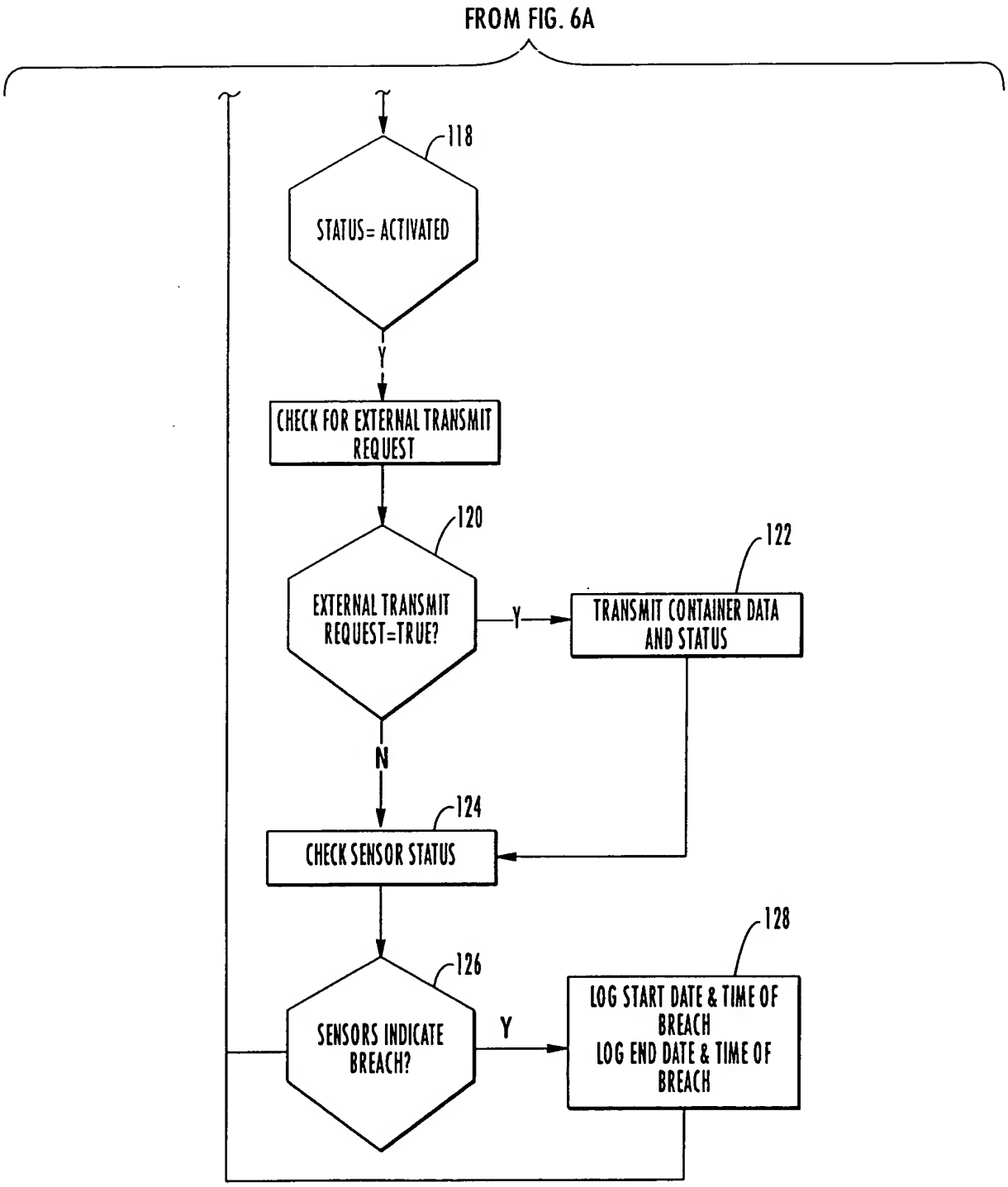
FROM FIG. 6A
118
STATUS= ACTIVATED
Y
CHECK FOR EXTERNAL TRANSMIT REQUEST
120
EXTERNAL TRANSMIT REQUEST=TRUE?
Y
122
TRANSMIT CONTAINER DATA AND STATUS
N
124
CHECK SENSOR STATUS
126
SENSORS INDICATE BREACH?
Y
128
LOG START DATE & TIME OF BREACH
LOG END DATE & TIME OF BREACH

FIG. 6B

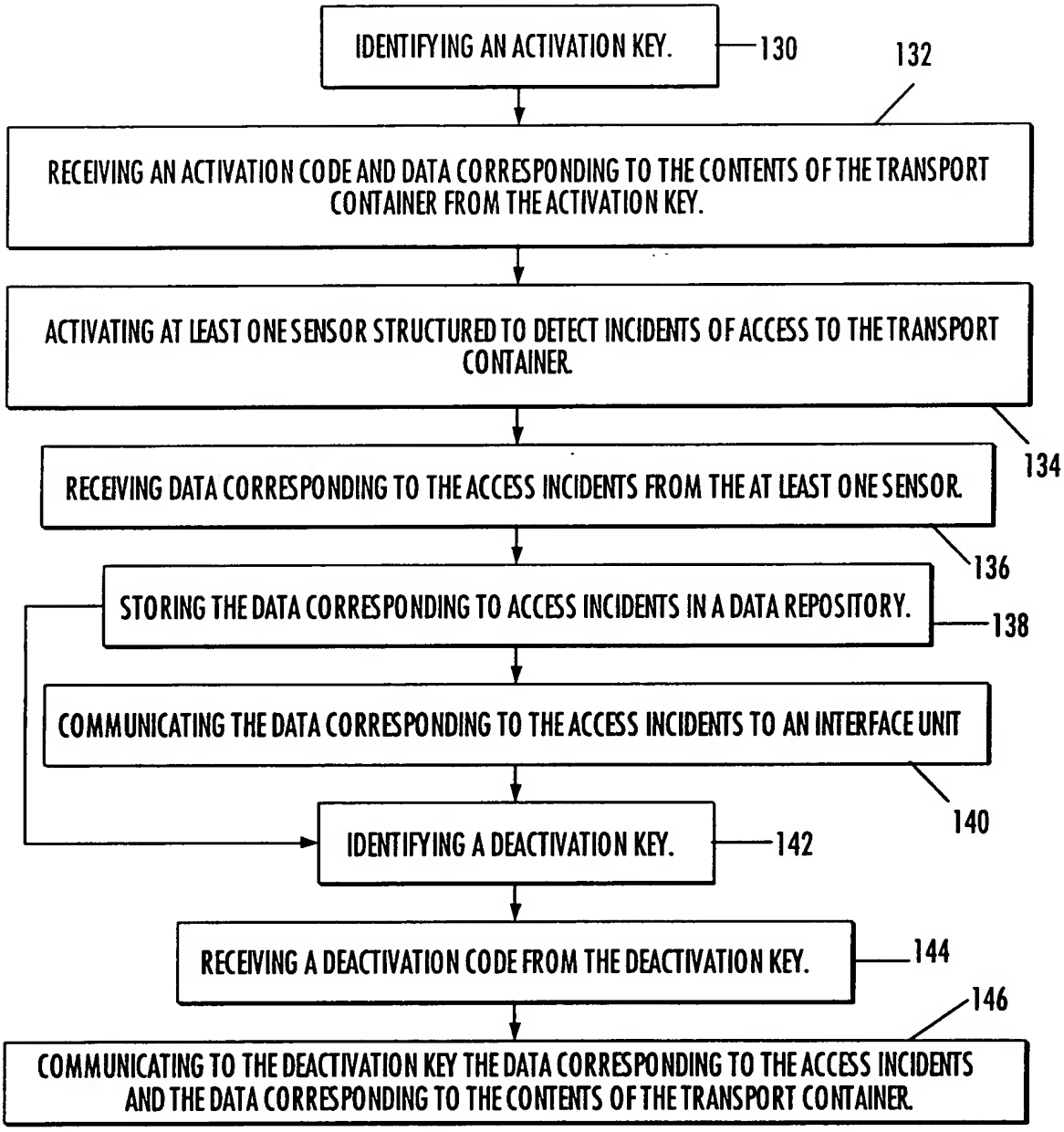
IDENTIFYING AN ACTIVATION KEY.
130
132
RECEIVING AN ACTIVATION CODE AND DATA CORRESPONDING TO THE CONTENTS OF THE TRANSPORT CONTAINER FROM THE ACTIVATION KEY.
ACTIVATING AT LEAST ONE SENSOR STRUCTURED TO DETECT INCIDENTS OF ACCESS TO THE TRANSPORT CONTAINER.
134
RECEIVING DATA CORRESPONDING TO THE ACCESS INCIDENTS FROM THE AT LEAST ONE SENSOR.
136
STORING THE DATA CORRESPONDING TO ACCESS INCIDENTS IN A DATA REPOSITORY.
138
COMMUNICATING THE DATA CORRESPONDING TO THE ACCESS INCIDENTS TO AN INTERFACE UNIT
140
IDENTIFYING A DEACTIVATION KEY.
142
RECEIVING A DEACTIVATION CODE FROM THE DEACTIVATION KEY.
144
146
COMMUNICATING TO THE DEACTIVATION KEY THE DATA CORRESPONDING TO THE ACCESS INCIDENTS AND THE DATA CORRESPONDING TO THE CONTENTS OF THE TRANSPORT CONTAINER.

FIG. 7

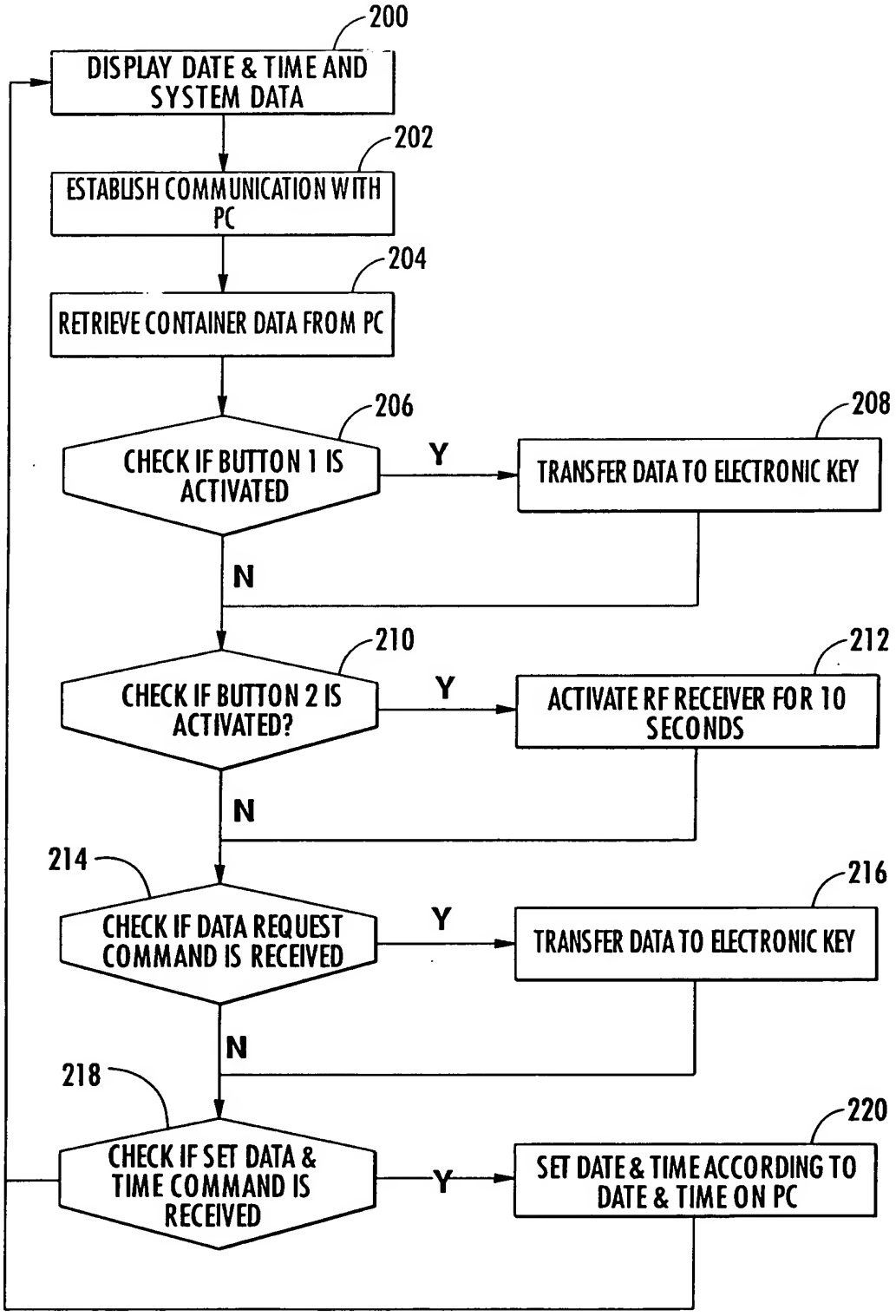
200
DISPLAY DATE & TIME AND SYSTEM DATA
202
ESTABLISH COMMUNICATION WITH PC
204
RETRIEVE CONTAINER DATA FROM PC
206
CHECK IF BUTTON 1 IS ACTIVATED
Y
208
TRANSFER DATA TO ELECTRONIC KEY
N
210
CHECK IF BUTTON 2 IS ACTIVATED?
Y
212
ACTIVATE RF RECEIVER FOR 10 SECONDS
N
214
CHECK IF DATA REQUEST COMMAND IS RECEIVED
Y
216
TRANSFER DATA TO ELECTRONIC KEY
N
218
CHECK IF SET DATA & TIME COMMAND IS RECEIVED
Y
220
SET DATE & TIME ACCORDING TO DATE & TIME ON PC

FIG. 8

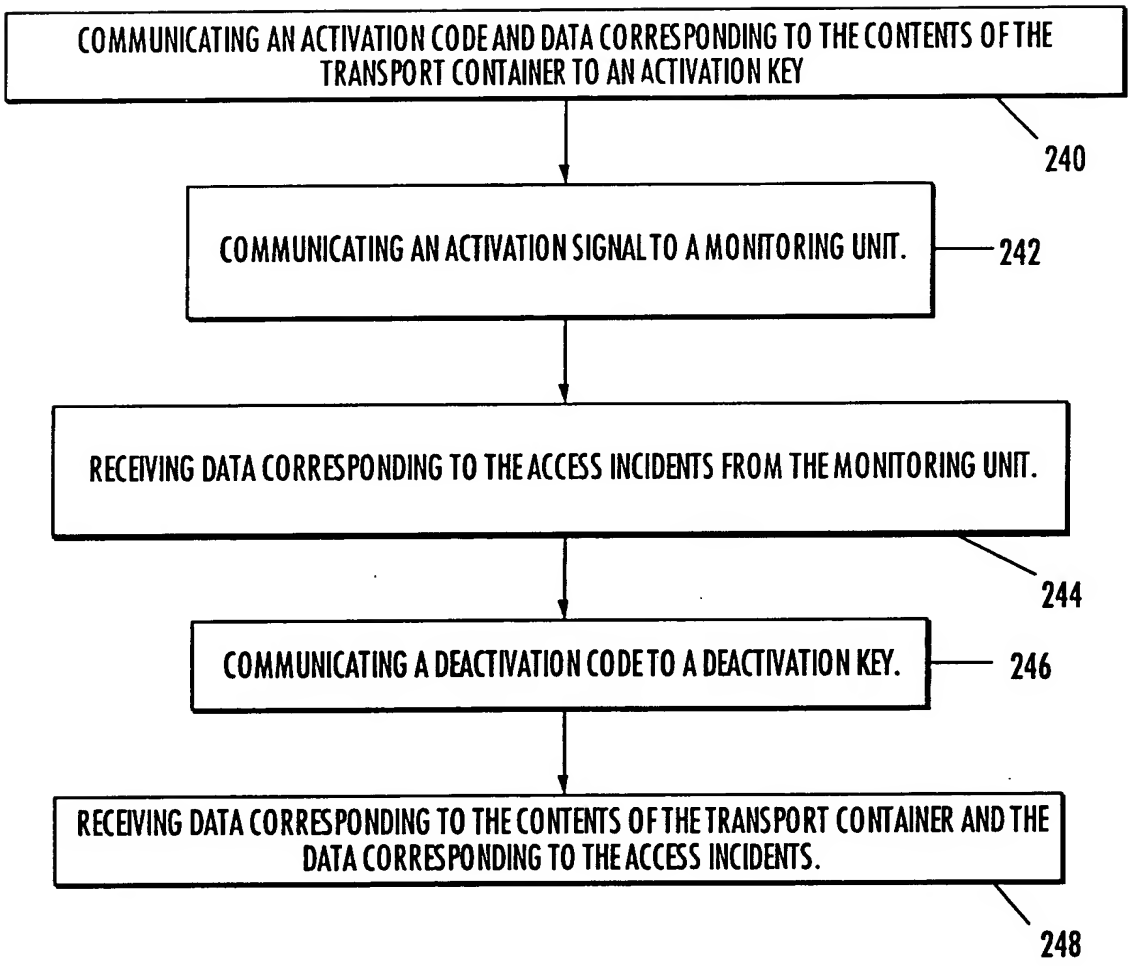
COMMUNICATING AN ACTIVATION CODE AND DATA CORRESPONDING TO THE CONTENTS OF THE TRANSPORT CONTAINER TO AN ACTIVATION KEY
240
COMMUNICATING AN ACTIVATION SIGNAL TO A MONITORING UNIT.
242
RECEIVING DATA CORRESPONDING TO THE ACCESS INCIDENTS FROM THE MONITORING UNIT.
244
COMMUNICATING A DEACTIVATION CODE TO A DEACTIVATION KEY.
246
RECEIVING DATA CORRESPONDING TO THE CONTENTS OF THE TRANSPORT CONTAINER AND THE DATA CORRESPONDING TO THE ACCESS INCIDENTS.
248

FIG. 9